Advant® OCS
with Master software

Advant® Controller 70

Version 1.2

Product Guide

3BSE 016 142R101

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Chapter 1 Overview

Advant Controller 70 is a small, low cost, modular controller for logic and regulatory control. It is designed according to the latest market requirements in size and flexibility and to suit a wide range of small applications. Advant Controller 70 can be used as a stand-alone station or it can be connected to an Advant Fieldbus 100. The Advant Station 100 Series Engineering Station (AS 100 Series ES) can connect to it for configuration. The PC-based HMI, AdvaSoft for Windows, can serve as the operator interface for Advant Controller 70.

Function Block Programming Language (AMPL) is used for application programming. Program entry, testing, documentation and fault tracing are supported by Advant Station 100 Series Engineering Station (ES) programming unit. The Advant Station 100 Series ES is a PC-based programming and service tool. It featuring graphical function chart programming and a user interface with windows, pull-down menus and "point and click" selection. Communication with the AC 70 is accomplished via a standard serial interface from the personal computer.

The I/O of Avant Controller 70 is highly modularized and flexible, providing easy installation of the I/O modules, process cabling and connection to drives systems. The I/O modules and termination units can be mounted and combined in many different configurations to fit your space requirements and suit many types of applications.

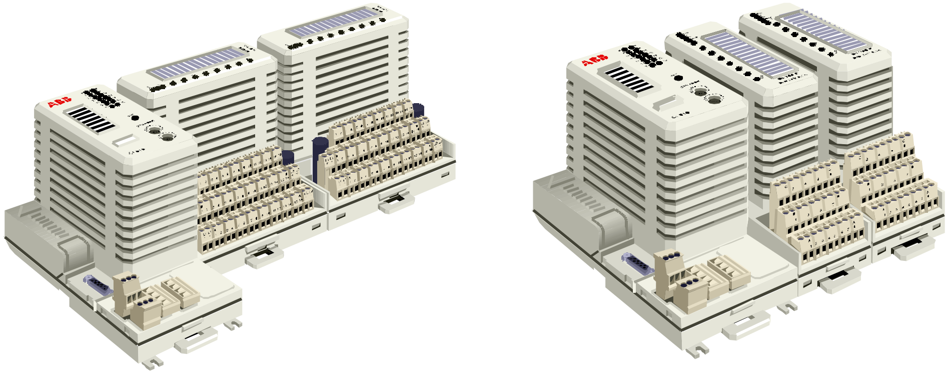

Figure 1-1. Advant Controller 70 processor unit and two I/O modules mounted on an extended or compact termination unit (MTU)

1.1 Product Benefits

Advant Controller 70 is specifically designed for small PLC-type applications, but brings also considerable problem-solving power to all analog signal handling and arithmetic applications. It is fully modular, with I/O modules plugged in Module Termination Units. Advant Controller 70 is perfect to live and grow with, thanks to its multitude of expansion possibilities and its on-line programming capability. It is designed to operate in demanding industrial environments to improve productivity, increase competitiveness and obtain peace of mind.

1.2 Features

Advant Controller 70 covers a wide range of functions such as:

- Logic and sequence control.
- Analog data handling.
- Arithmetic and regulatory control.
- Support of easy integration with Drives Units, for example, ACS 600.
- Support of true sequential event recording thanks to accurate at-the-source, time tagging of events.
- Support a broad scope of S800 I/O modules, with a maximum capacity of 384 digital and 192 analog I/O points.
- Support of local and central HMI for manual control operations, event and alarm handling, trend curve presentation etc.
- Built-in RS 232 interface for MODBUS I.
- Support of Advant Fieldbus 100 with cable length up to 15,000 meter.
- Configurable directly connected or via Advant Fieldbus 100.
- Communicates over Advant Fieldbus 100.

The I/O features are:

- Quick faultfinding with help of LEDs of each module and channel.
- Easy connection to drives systems, minimizing communication delays and cost.
- All modules have plastic injection molded enclosures which provide safety protection degree IP20 according to IEC 529.
- I/O modules are protected from destruction by a mechanical keying arrangement if an attempt is made to insert a module type in a position with a different key code than the factory set code of the I/O module. MTUs have keys which are set to key code of its I/O module’s key code.
- An electrical ID is checked at start-up, if this does not match the configured type, the I/O module is not taken into operation.
- Hot-swap of I/O modules allowing replacement of faulty modules without disconnecting field power or system power to the I/O-station.
- I/O modules allow for 55^{o}C ambient temperature except for vertical mounted Compact MTU with I/O modules allow for 40^{o}C ambient temperature.

1.3 Terminology

The term Engineering Station is used for Advant Station 100 Series Engineering Station.

The term Operator Station is used for AdvaSoft for Windows, AdvaSoft 2.0 for Windows NT, Sattgraph 5000, or any other HMI.

The term Advant Controller 400 Series is used for Advant Controller 410 and Advant Controller 450.

The term DB is used for Data Base and DB element is used for Data Base element.

Chapter 2 Functional Description

2.1 Controller Basics

2.1.1 Start-up of the Controller

You can configure the start-up mode of Advant Controller 70 to:

- Stop
- Clear (cold start), or
- Auto (warm start).

In **stop** mode, Advant Controller 70 tries to install a connection to Advant Fieldbus 100, but it will not start executing an application program. Instead, the controller waits for a command to be given by the Engineering Station that it is connected to.

In **clear (cold start)** mode, Advant Controller 70 performs its self-tests, checks the user flash PROM for a valid application program and starts executing it. Then the controller performs a complete initialization and configuration of all I/O modules.

In **auto (warm start)** mode, Advant Controller 70 first checks for a valid RAM content. In case of a short power failure data is stored there to allow the controller to continue execution of the application from the point prior to the interruption. If necessary, the I/O modules have to be configured again.

2.1.2 Process Control

Program entry, testing, documentation and fault tracing are supported by Advant Station 100 Series Engineering Station.

The Engineering Station is an IBM PC-based programming and service tool. It features graphical function chart programming and a user interface with windows, pull-down menus and “point and click” selection.

Communication between Engineering Station and Advant Controller 70 is accomplished via the standard serial interface.

An application program for an Advant Controller 70 consists of a Data Base (DB) part and a Process Control (PC) program. Both parts cannot be loaded separately, the application program can only be loaded as a whole.

Process control applications are programmed in ABB Master Programming Language (AMPL). AMPL is a function block oriented language with graphical representation. It has been developed for process control applications. The building blocks are called PC elements. There is a wide range of PC elements available, from simple AND blocks to complete PID regulators. The controller can be programmed in AMPL fully on-line, that is, while running the application and controlling the process. Cycle times of the PC programs are selectable in the range from 2 ms to 20 s in steps of 2 ms.

Configuration data and parameters for the processor module, the Advant Fieldbus 100, all I/O modules as well as process data and local data is stored in the DB part via Data Base elements. The PC program has access to most of the data in the DB part including all process variables.

Configuring the S800 I/O system means creating DB elements and entering parameters for each I/O module and its channels. Typical parameters are tag name, signal range, filter time, etc.

I/O modules are scanned cyclically, where the cycle time is selectable in the range of 2 to 100 ms in steps of 2 ms. Minimum cycle time depends on the number and type of I/O modules to be scanned. The I/O values are stored in an internal memory of the Advant Controller 70 which is read/written with the cycle time of the PC programs (PCPGM, CONTRM, SEQ, MASTER).

Diagnostic functions supervise the system at start up and during normal operation. The status of the modules are indicated by LEDs and are also accessible by terminals on the DB element.

DB Elements

DB elements exist for

- the processor module
- all S800 I/O modules and its channels
- local data and parameter of various data types
- Advant Fieldbus 100 support
- MMI support
- Drives support

PC Elements

The range of ready-to-use PC elements is wide and powerful. It contains elements for:

- Logic Control
- Time Delays
- Sequence Control
- Data Converting
- Calendar Time Functions
- Arithmetics
- Regulatory Control
- Pulse counting.

The PC elements are listed under the program modules in Chapter 3, Software Components.

User Defined PC Elements

Another way to implement your frequently used control solution and ensure a fully integrated engineering environment is to use the option for creating own PC elements.

A user defined PC element has the same look-and-feel as a standard PC element.

2.2 I/O System

Analog Inputs

- Single ended input modules can be configured as 0..20mA, 4..20mA, 0..10V, 2..10V.
- Differential input modules can be configured as -20..+20mA, 0..20mA, 4..20mA, -10..+10V, 0..10V, 2..10V, -5..+5V, 0..5V, 1..5V.
- Values are represented by 0–100%
- The modules have 12 bit resolution.

PT 100 Inputs

- All values are used in the system as engineering units, selectable between degrees F and C.
- Temperature ranges: -200..850°C for Pt 100, -80..+260°C for Ni 120 -100..+260°C for Cu 10, 0..400Ω for resistive pick ups.
- The suppression frequency is selectable between 50 and 60 Hz.
- The module has 15 bit resolution.
- Automatic testing and self calibration is provided within the module.

Thermocouple Inputs

- All values are used in the system as engineering units, selectable between degrees Fahrenheit and Celsius.
- Thermocouple inputs are available for the sensor types B, C, E, J, K, N, R, S and T
- The suppression frequency is selectable between 50 and 60 Hz.
- The module has 15 bit resolution.
- Automatic testing and self calibration is provided within the module.

Analog Outputs

- Analog outputs of different types are available: 0..20mA, 4..20mA, -20..+20mA, 0..20mA, 4..20mA, -10..+10V, 0..10V, 2..10V, -5..+5V, 0..5V, 1..5V
- Values are represented by 0–100%.

Digital Inputs

- Modules for different input voltages (24–48 V d.c., 120–230 V a.c.) and load currents are provided both with solid state inputs and relay inputs.

Digital Outputs

- Modules for different output voltages (24–48 V d.c., 24–230 V a.c.) and load currents are provided both with solid state outputs and relay outputs.

Pulse Counter

- Module for pulse counting and frequency measurement up to 1.5 MHz.

2.3 Drive Support

Drive support for ACS 600 type of drives is available as programmable function in Advant Controller 70. The drives are connected in a ring to the optical modulebus extension. The function consists of:

- DB element DRIDS exchanges data with the drive. Each DRIDS sends three values to the drive (for example, commands and speed set point) and obtains three values from the drive (for example, status, speed and current)
- DB element DRISTD represents a standard drive, which has the product name ACS 600 with Standard Application. The DRISTD DB element can refer up to two DRIDS element.
- DB element DRIENG represents an engineered drive, which has the product name ACS 600 with System Application. The DRIENG DB element can refer up to 10 DRIDS elements.
- PC element DRI-CNV converts and scales set points and actual values which are exchanged with the drive.

2.4 Advant Fieldbus 100

General Features

Advant Fieldbus 100 is a high speed communication link (1.5 Mbit/s) intended for communication between Advant Controllers and Advant Stations over a distance up to 15,000 m.

Advant Controller 400 Series, Advant Controller 110, Advant Controller 160, Advant Controller 70, S800 I/O Station, Operator Stations, and other equipment are adapted for the bus.

Advant Fieldbus 100 is a high-performance bus specifically designed for real time applications. It features reliable, cyclic (deterministic) data transfer (using Data Set Peripherals), as well as event-driven background transfer of service data.

Up to 10 Operator Stations or Advant Controller 400 Series can receive alarm and events from one or several Advant Controller 70.

Service data transfers allow remote access from an Operator Station, Advant Controller 400 Series or Advant Controller 100 Series to any Advant Controller 70 on the bus. With remote access from an Engineering Station connected to an Advant Controller 400 Series or Advant Controller 100 Series, it is possible to configure or test any Advant Controller 70 connected to the same bus.

The station status of each controller is cyclically distributed on the Advant Fieldbus 100. The distributed station status can be accessed by the application via the “AF100 station diag” and “AF100 ext diag” parts at data base element PM810. The station status from other Advant Fieldbus 100 nodes can be accessed via data base element AF100S.

Detailed information about the Advant Fieldbus 100 is given in the Product Guide for Advant OCS with Master Software, Overview, and the *Advant Fieldbus 100 User’s Guide*.

AF 100 Cable Length Configuration

Advant Controller 70 1.2 running on a PM810V1 or PM810V2 takes over the AF 100 cable length (2000, 8500, or 15000 m) distributed by a CS522 and reports it at terminal LENGTH of DB Element PM810. If there is no length distributed by the AF 100 bus master, the default value of 2000 m will be set up.

2.5 Event Handling

Advant Controller 70 supports event detection and transfer of time-tagged events to Advant Controller 400 Series, Advant Controller 100 Series, or an Operator Station via Advant Fieldbus 100.

Advant Controller 70 can create events from digital and analog values. For specific information on Event Set, refer to the book, *AMPL Configuration Advant Controller 100 Series Reference Manua*l.

In case of digital signals represented as PC variables of type Boolean, events can be generated as result of a status change by using the Data Base Element DIC. Such a calculated event is time-tagged by Advant Controller 70 as soon as the event is detected.

For analog signals represented as PC variables of type Real, events can be generated in case of limit violation by using the Data Base element AIC. Time-tagging is done when the value violates the limit.

If there are several event sinks, e.g. AdvaSoft for Windows, and some of them stall, the event transfer to the remaining ones can be disturbed for about 30s to 60s depending on the number of operator stations which have gone down. This time can be reduced by creating an AF100S Data Base Element for each event sink. The station status is supervised and after 4 seconds a missing event sink is detected and no events will be sent to missing event sinks. When the event sink is up and running again the event transfer will be re-enabled by the event sink.

2.6 Time Synchronization

Advant Controller 70 is able to act as a time synchronization slave on Advant Fieldbus 100. Once enabled, it will update the internal clock every second with data from the time synchronization master, for example, Advant Controller 400 Series or Advant Controller 100 Series.

2.7 Central Operator Station

Communication with a central Operator Station — e.g., AdvaSoft for Windows— is possible via Advant Fieldbus 100.

One Advant Controller 70 can communicate with up to 10 AdvaSoft for Windows nodes simultaneously. This also applies to AdvaSoft 2.0 for Windows NT or Sattgraph 5000 connected through Advant OPC Server for AF 100.

You will need the Advant Controller 70 software option “Event Handling” – which is part of the Advant Controller 70 Basic Unit – to communicate with the Operator Station.

2.8 Local Operator Station

The local operator station communicates with Advant Controller 70 via the MODBUS I (binary) protocol on the serial interface of the processor module. Master of this communication link is the Operator Station.

The MODBUS facility can be installed on Advant Controller 70 by MODBUS I SW Driver on the second serial interface of MODBUS connection kit for AC 70 CPU module and Advant Controller 70 OPT MODBUS I.

2.9 Function Table

A large variety of configurations is possible with Advant Controller 70 and its I/O, both software and hardware. Software options are available as one or several program modules. Optional hardware units are I/O modules, etc. Table 2-1 summarizes the various options and configuration alternatives applying to Advant Controller 70.

Table 2-1. Functions and configuration alternatives for Advant Controller 70

Function	Program module	Hardware	Peripherals
PC elements for logic, arithmetic & data handling	AC70 Base SW	PM810	
PC elements for regulatory control	OPT Extended PC elements	PM810	
User defined PC elements	Extension Disk	PM810	
On-line AMPL program editing	AC70 Base SW	PM810	Engineering Station
Event Handling	AC70 Base SW	PM810	
S800 I/O modules support	AC70 Base SW	See Chapter 8, Ordering	
Advant Fieldbus 100	AC70 Base SW	See Chapter 8, Ordering	

Table 2-1. Functions and configuration alternatives for Advant Controller 70 (Continued)

Function	Program module	Hardware	Peripherals
Support for AdvaSoft for Windows	AC70 Base SW	See corresponding Product Guide	AF 100
Support for ACS 600 motor drives	AC70 Base SW	PM810	Motor Drives ACS 600
Local operator station	OPT MODBUS I	PM810	MODBUS - MMI
PROM back-up of application program (PC and DB part)	AC70 Base SW	PM810	

Chapter 3 Software Components

The system software of Advant Controller 70 is based on one basic program module to which optional program modules can be added. The optional program modules can be freely combined to solve any application task. The program modules and their content is described in the subsequent chapters.

3.1 Basic Program Module

The Advant Controller 70 system software comprises a real time operating system, an AMPL element library, diagnostic functions, and interfaces to Engineering Station and Operator Stations. The application program is stored in a nonvolatile memory. At start-up it is copied from the nonvolatile memory to the RAM memory where it is executed.

The application program consists of one AMPL program, (one PCPGM) and up to 31 subordinate execution units (CONTRM, SEQ or MASTER). These are executed cyclically with execution times selectable from 2 ms to 20 s. It is also possible to define subordinated execution units (CONTRM) that are executed once at cold start or warm start. The start-up sequence can be defined by the user.

Diagnostic functions monitor the system operation and report any fault found. The monitoring functions include a watchdog, bus supervision and memory checking.

Faults are indicated on the LED display on the front of the module. More detailed diagnostic information can be obtained with an Engineering Station.

The basic program module has a functional contents in accordance with:

- Logic control and time delays
- Advant Fieldbus 100 communication
- Arithmetic Sequence control
- Connection to Advant Controller 400 Series
- Calendar time functions.

Most of the mentioned functions are realized with one or several PC elements. The contents of the PC element library in the basic program module is shown in Table 3-1.

Table 3-1. PC elements in the basic program module

Type	PC element
Structure	PCPGM, CONTRM, FUNCM, MASTER, SLAVEM, BLOCK, SEQ, STEP
Bitwise operation on the integer data type	BGET, BSET
Combinational	AND, AND-O, OR, OR-A, XOR, INV, THRESH-L, SR, SR-AA, SR-AO, SR-OA, SR-OO, SR-D
Arithmetic	ADD, ADD-MR, SUB, MUL, MULDIV, DIV, DIV-MR, ABS, SQRT, LIM-N
Time	MONO, TON, TOFF, TON-RET, TRIGG, AND-TRG, OR-TRG, OSC-B, TIMER, SYSTIME
Registers	FIFO, MOVE, REG, SHIFT
Multiplexers	MUX-I, MUX-MI, MUX-MN
Code converters	CONV, CONV-BI, CONV-IB, DRI-CNV
Counters	COUNT
Comparators	COMP-B, COMP-I, COMP-R, MAX, MIN
Switches	SW, SW-C
Supervision	SYSL

3.2 Optional Program Modules

3.2.1 Extended PC Elements

The optional program module “OPT: Extended PC Element Set” extends the PC element library included in the basic program module with PC elements for supporting the function Regulatory control. Regulatory control is realized with PC elements. The contents are shown in Table 3-2.

Table 3-2. Additional PC elements in program module “OPT: Extended PC”

Type	PC element
Registers	REG-G
Function generator	FUNG-1V
Filter	FILT-1P
Feedback	P-1, INT, DER, PI, PID, PIP, PDP, CON-PU1, RAMP

3.2.2 Event Handling

Optional program module “OPT: Events” extends the functionality of the controller with event handling:

- Detection of events from digital or analog output terminals (calculated events)
- Time-tagging of events
- Event handling and event transfer via Advant Fieldbus 100.

3.2.3 Modbus I RTU

The Optional program module “OPT: Modbus I RTU” extends the functionality of the controller with the MODBUS I protocol (RTU, binary mode), which is intended for communication with a local Operator Station or panel.

The separate serial interface on the processor modules is used for this purpose. The MODBUS connection kit is required. The following MODBUS functions (read/write commands) are supported:

- 01 = Read coil status
- 06 = Load single register
- 02 = Read input status
- 07 = Read exception status
- 03 = Read holding register
- 08 = Diagnostic loop-back
- 04 = Read input register
- 15 = Force multiple coils
- 05 = Force single coil
- 16 = Load multiple registers

Advant Controller 70 is defined as MODBUS slave. The address is set by Advant Station 100 Series Engineering Station in DB element MODCHAN.

3.3 Further Extensions

A dedicated diskette “System SW Extension disk” (article number 3BSE 011 280R1) can be obtained to create application specific PC elements for Advant Controller 70. The diskette includes all necessary documentation and specific tools. However, commercially available tools for the development ewnvironment such as compiler, linker, loader and assembler must be purchased separately.

Chapter 4 Hardware Components

4.1 System Unit Overview

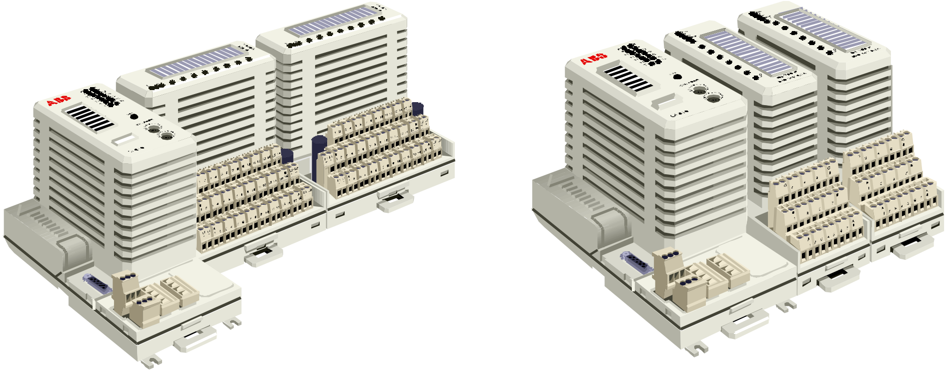

Figure 4-1. Advant Controller 70 processor unit and two I/O modules mounted on an extended or compact termination unit (MTU)

The hardware for Advant Controller 70 consists of a processor module, I/O Modules, Optical Modulebus Modems, mounted on DIN rails, bus terminators and external power supplies. The modules can be mounted on standard DIN-mounting rails according to DIN EN50033-35*15.

Advant Controller 70 is fed by a single or redundant supply voltage of 24 V d.c. A selection of power supplies (120/230 V to 24 V d.c., for example, power supply module SD811 ac SD812) are available to supply the unit and its field circuits. The processor module provides supervision function for redundant voltage supply. When breaking up an Advant Controller 70 station into smaller parts, the following rules apply for configuration:

- Up to 7 Optical Modulebus Modems TB820 can be used to build up 7 additional clusters containing up to 12 I/O modules each. The total maximum of I/O modules is limited to 24. The Optical Modulebus expansion cable TK 811 is connected to the PM810V1 via the Modulebus Optical Port TB810.

When breaking up a cluster into smaller parts, the following rules apply for configuration:

- The parts must be connected by Modulebus Extension cable TK801. The following length of Modulebus Extension cables are supported: 0.3 m, 0.6 m and 1.2 m. Extension cables are connected to the Modulebus via cable adaptors TB805/TB806.
- All parts, within one base or I/O cluster, must be put in the same cabinet (same grounding potential)
- The maximum length of the complete station including processor module, Modulebus Extension cables, cable adaptors and MTUs is 2 meters (7 ft.).

Maximum layout of an Advant Controller 70 with 24 I/O modules results in maximum 384 digital or 192 analog I/O signals. Maximum I/O signals varies if module types are mixed.

The S800 I/O Product Guide gives a complete overview about I/O modules, MTUs, power supply and the module bus.

4.2 Basic Unit

The Basic Unit AC70 has the following characteristics:

- It contains a Motorola MC68340, 16 MHz processor, 512 kbytes nonvolatile memory (Flash PROM) for the user built application and 512 kbytes nonvolatile memory (Flash PROM) for the system software. At start-up the application is copied from the nonvolatile memory into RAM memory where it is executed. There is a sum of 512 kbytes RAM available for operating system and application, of which at least 256 kbytes are free for application programs. The memory is not expandable.
- The RS-232C port dedicated for connection of Advant Station 100 Series engineering stations and to MODBUS using the MODBUS connection kit.
- The unit can be switched off for 270 days without losing the RAM content.

The basic unit is described in the table below:

Table 4-1. Basic Unit

Consists of	Description
PM810	Processor module.
TB807	Modulebus Termination.
SW BASE incl. Event Handling on two 3.5” diskettes.	Base software and software for Event handling.

4.3 Communication

The processor module PM810 has two connectors and modems for Advant Fieldbus 100 (media type twisted pair) and a connector for the Modulebus Optical port module. The Advant Fieldbus 100 connection can be either single or redundant.

Removable terminals allow exchange of PM810 without disconnecting the other nodes of the fieldbus. The processor module provides a supervision function for redundant Advant Fieldbus 100 lines. Advant Controller 70 can act as slave on Advant Fieldbus 100. Master on Advant Fieldbus 100 can be an Advant Controller of type 100 Series or 400 Series or an Operator Station.

Various modems are avaiable to connect differrent Advant Fieldbus 100 media types (twisted pair or coaxial) and to connect Advant Fieldbus 100 communication interfaces in Advant Controller 400 Series and Advant Controller 100 Series to twisted pair media.

The front plate of the processor module provides LEDs for diagnostic and status indications of Advant Fieldbus 100. Two rotary switches are provided for setting the Advant Fieldbus 100 station address. No other addresses are required to be set within the I/O station. Labels for optional user text and item number are also provided.

The service port, RS 232, of the processor module, is galvanically isolated to allow trouble free connection to the engineering tool or via MODBUS.

4.4 S800 I/O

A range of I/O modules is available, covering analog,digital, and pulse signals of various types. The process signals are connected to MTUs. The *S800 I/O Hardware User's Guide* gives more details about these modules. The *S800 I/O Product Guide* gives a first overview.

The following S800 I/O modules are supported:

Table 4-2. S800 I/O modules supported by Advant Controller 70

Module type	Type designation
AI	AI810, AI820, AI830, AI835
AO	AO810, AO820
DI	DI810, DI811, DI814, DI820, DI821
DO	DO810, DO814, DO815, DO820, DO821
DP	DP820

Chapter 8.5, Ordering gives more details on the various I/O modules available for Advant Controller 70.

Chapter 5 Mechanical Design

Mechanically, Advant Controller 70 consists of DIN rails, modules and module termination units (MTUs).

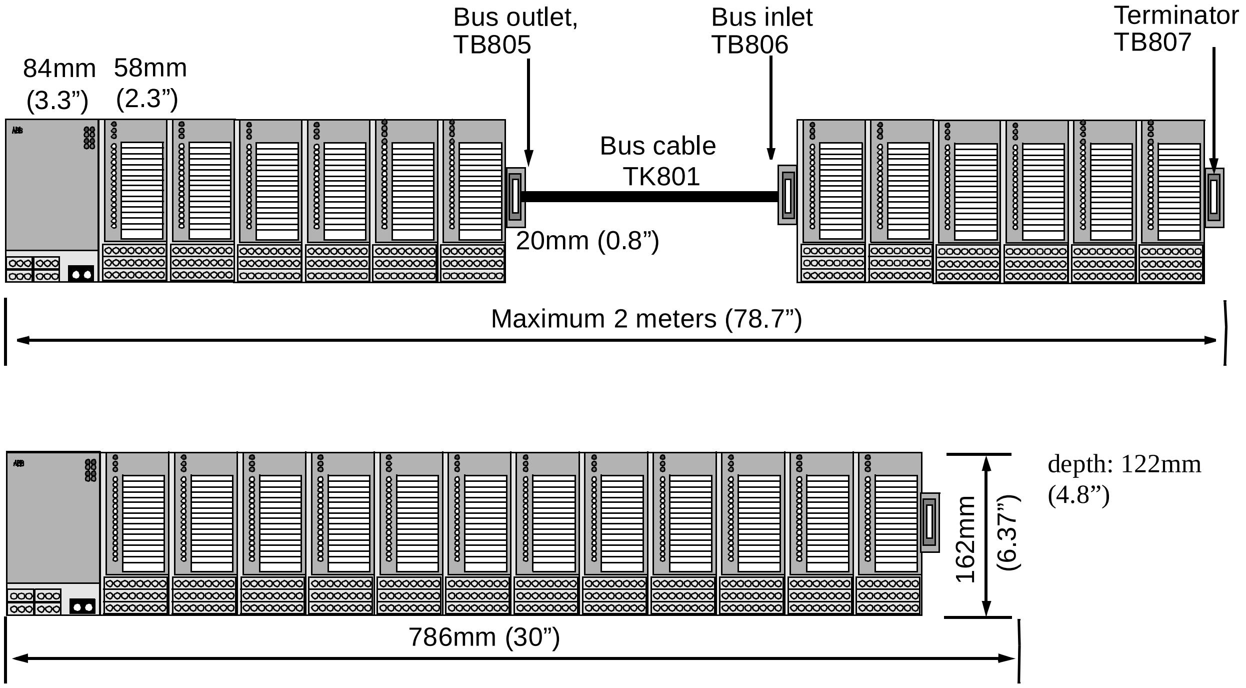

Figure 5-1. Maximum layout of Advant Controller 70 with Compact MTUs

Chapter 6 Technical Data and Performance

6.1 General Data

The general data for Advant Controller 70 are given in Table 6-1.

Table 6-1. The maximum configuration of Advant Controller 70

Item	Max. no.
I/O signals (digital/analog)	384 / 192
I/O modules	24
I/O Clusters	7 (8 in total)
Processor modules (PM810)	1
Standard drive, connected via optical bus	24
Engineered drive, connected via optical bus	12

Restriction: (No. I/O modules) + (No. Standard Drives) + (2 × No. Engineered Drives) ≤ 24.

6.2 Data Set Communication

Data set (DS) elements hold references to DAT elements. Up to eight DAT elements can be connected to one data set. A DAT element can hold one variable representing:

- 32 Booleans (32 bits) or 1 real number (32 bits) or
- 1 long integer number (32 bits) or 1 short integer number (16 bits).

The data set communication service cyclically transfers information from the DAT elements specified in the sending controller to the DAT elements specified in the receiving controller. The cycle time for each data set can be selected between 1 ms and 4096 ms.

The data set communication service is based on the broadcast principle, allowing any station to receive any data set sent on the bus. The advantage of broadcasting is that information only needs to be transmitted once regardless of the number of receiving stations. This principle is highly efficient when the same information is required in two or more stations, especially in time-critical applications.

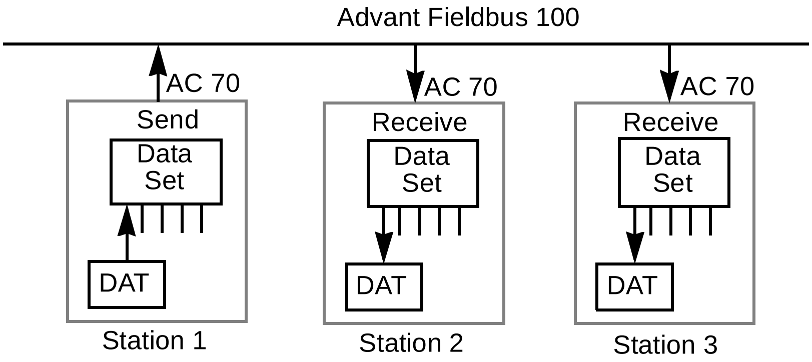

Figure 6-1. Data Set communication

The data set communication uses resources on Advant Fieldbus 100, in the communication modules and also in the CPU.

Table 6-2. Data set communication (per AC 70)

Description	Data
Total number of data sets (per controller)	50
Maximum number of sending data sets (per controller)	50
DAT elements per data set	1…8
Selectable cycle times	1,2,4,…,4096 ms

Advant Fieldbus 100 runs at 1.5 Mbits/s. Table 6-3 shows the transfer time for one data set.

Table 6-3. Data set transfer times for Advant Fieldbus 100

Data set size (DAT element per data set)	Transfer time Ttr (ms)
1	0.088
2	0.108
4	0.156
8	0.252

To estimate the bus load for a given application, use the following formula:

Bus load in % = $((\mathbf{N} \times \mathbf{T_{tr}}) / \mathbf{T_c}) \times 100\%$, where
N = the number of data sets (of the same size and Tc)
$\mathbf{T_{tr}}$ = the transfer time in ms (from the above table)
$\mathbf{T_c}$ = desired cycle time in ms (1, 2, 4, 8, 16…4096)

The resulting load should not exceed 80%, the remaining capacity must be reserved for background communication (for example, remote programming).

NOTE

Include only the sending data sets in the calculation.

6.3 Event Transfer and Detection

In an Advant Controller 70, you can use calculated DI elements (DIC) and AI elements (AIC) to generate events. After detecting an event, it can be transferred via Advant Fieldbus 100 to a controller in Advant Controller 400 Series or Advant Controller 100 Series or to the AdvaSoft for Windows for further treatment. For each event queue (DB element EVS(S) in the Advant Controller 70), up to 10 nodes on the Advant Fieldbus 100 network can be assigned to receive this event message.

Table 6-4. Event transfer and detection

Description	Maximum No.
Number of event queues per AC 70	32
Number of entries per event queue	1000
Number of event set elements per AC 70	32
Number of event detection elements per event set element	32
Total number of event detection elements per AC 70	512
Number of event generating slaves	16

Table 6-5. Event transfer and detection resolution

Description	Minimum.
Resolution of calculated events	10 ms

6.4 Interface to a Local Operator Station

The Advant Controller 70 processor module includes an asynchronous serial interface (channel 2), which may be used for communication with a local Operator Station. Advant Controller 70 exchanges data with the Operator Station via PARDAT Data Base elements. The supported communication protocol on this serial interface is the MODBUS I protocol (RTU, binary mode). The MODBUS address can be set in DB element MODCHAN.

6.5 Cycle and Scan Times

An Advant Controller 70 application program consists of one AMPL program (PCPGM) which can be further divided into maximum 31 execution modules (CONTRM, MASTER) or sequence modules (SEQ). Different cycle-times and priorities may be assigned to the execution modules so that the AMPL program can include both fast and slow control functions. Cycle times can be chosen from 2 ms to 20 s in steps of of 2 ms. Control modules with shorter cycle times always have a higher priority than those with longer cycle times. The execution order of modules with equal cycle times or activation at cold start or warm start can be selected explicitly by the CONTRMs call parameter C2.

6.6 I/O Scanning

Scanning of I/O modules is done asynchronously to the execution of the control modules.

I/O modules are scanned cyclically, where the cycle time is selectable at the input terminal IOSCANT at the PM810 Data Base element in the range of 0 to 100 ms in steps of 2 ms. The minimum cycle time depends on the number and type of I/O modules to be scanned. The actual cycle time can be read from the output terminal ACTSCANT at the PM810 DB element. The I/O values are stored in an internal memory in the Advant Controller 70 which is written/read by the control modules (CONTRMs).

Each execution module reads its inputs before executing its AMPL elements. This guarantees a consistent image of the process signals. After execution of the AMPL elements, the module writes the calculated results to the outputs.

To optimize the load from I/O scanning some modules are not scanned in every scan cycle. A scanning ratio 10 means that this module is scanned in every 10th scan cycle, that is, if ACTSCANT = 8 an AI810 is scanned every 32 ms.

Table 6-6. Scanning ratio values

Module Type	Scanning Ratio
AI810, AI820	4
AI830, AI835	10
AO810, AO820	4
Digital inputs	1
Digital outputs	1
DP820	1
DRISTD	1
DRIENG (see DRIDS below)	
DRIDS at REF1or REF2	1
DRIDS at REF3 to REF5	4

Table 6-6. Scanning ratio values (Continued)

Module Type	Scanning Ratio
DRIDS at REF6 or REF7	10
DRIDS at REF8 to REF10	40
PM810	1

Table 6-7. Execution Times

Module Type	T_i = Execution Time
Digital inputs	0.230 ms
Digital outputs	0.250 ms
Analog inputs (AI810, AI820)	0.225 ms × number active channels
Analog inputs (AI830, AI835)	0.030 ms × number active channels
Analog outputs (AO810, AO820)	0.090 ms × number active channels
Pulse counter (DP820)	1040 ms
DRIDS at REF1or REF2	0.250 ms
DRIDS at REF3 to REF5	0.070 ms
DRIDS at REF6 to REF10	0.025 ms
PM810	0.840 ms

Table 6-8. Scan Times

Module Type	S_i = Scan Time (1)
AI810	4.500 ms
AI820	2.250 ms
AI830, AI835	0.600 ms
AO810	1.800 ms
AO820	0.900 ms
Digital inputs	0.645 ms
Digital outputs	0.645 ms
DP820	2.600 ms

Table 6-8. Scan Times (Continued)

Module Type	S_i = Scan Time [1]
DRISTD	1.300 ms
DRIENG	2.600 ms
PM810	2.100 ms

[1] S_i is the time which each module contributes to the total I/O Scanning cycle time

The smallest possible I/O Scanning cycletime S_{min} (in ms) can be calculated from the following formula:

$$S_{min} = \sum_i S_i$$

where

S_i = scan time of I/O scanning, (Table 6-8)

S_{min} = rounded up to the next multiple of 2 ms

6.7 CPU Load Calculation

To determine the CPU load for an Advant Controller 70, the following points should be considered:

- 20% of the total available CPU capacity should be reserved for basic system functions.
- The remaining 80% CPU capacity is available for the application program.

The formula for calculating the load is:

Load in % = $((\mathbf{N} \times \mathbf{T}) / \mathbf{T_c}) \times 100\%$, where

N = number of functions, **T** = function execution time (ms), $\mathbf{T_c}$= function cycle time (ms).

The following table gives some typical execution times for load approximations. The figures are primarily intended for checking whether or not a system is close to the maximum load.

Table 6-9. Execution times, basic processing and I/O functions

Type	Description	Execution time T (ms) [1]
Logic	1 AMPL element AND, OR, (with 2 inputs)	0.019
Logic	1 AMPL element INV	0.010

Table 6-9. Execution times, basic processing and I/O functions (Continued)

Type	Description	Execution time T (ms) (1)
Logic	1 AMPL element XOR (with 2 inputs)	0.015
Logic	1 AMPL element AND, OR (with 4 inputs)	0.025
Arithmetic	1 AMPL element ADD, SUB (with 2 inputs)	0.036
Arithmetic	1 AMPL element MUL, DIV.	0.055
Digital I/O	1 DB element DI, with 16 channels	0.200
Digital I/O	1 DB element DO, with 16 channels	0.120
Analog I/O	1 DB element for AI, with 8 channels	0.150
Analog I/O	1 DB element for AO, with 8 channels	0.080

(1) Mean value. Scan time for I/O scanning must be added to these figures

Table 6-10. Execution time of regulator function

Type	Description	Execution time T (ms)
PI loop	A simple analog control loop consisting of: • 2 DB elements AI/AO with one AI/AO signal connected • 1 AMPL element PI • 4 AND(2) and 4 ADD(R,2) AMPL elements	3.0

6.8 CPU Load Calculation, Data Set Communication

The CPU load from data set communication can be estimated from the example detailed in Table 6-11.

Table 6-11. CPU Load Calculation

Data set size (bytes)	Data sets/s	Load per Data set and second	Load on sending controller (1)	Load on receiving controller (1)
4	500	0.034	17	17
16 (2)	500	0.05	25	25

(1) Optimized example: DSP with 32 ms scan factor, PCPGM with 32 ms cycle time and CONTRM with 32 ms cycle time accessing all DATs.

(2) Applies to the data types IL, B and R

6.9 Memory Requirements

256 kbytes of memory is available for the application program. For a rough calculation of the application memory requirements, use Table 6-12.

Table 6-12. Memory requirements for seven different application programs

Program No.	Program description	Input/Output Data Set	Needed memory size (kbytes)
1	1 CONTRM with 16 × 3 input AND, 3 DI810 and 1 DO810	48 inputs 16 outputs	4.5
2	1 CONTRM with 32 × 2 input AND 4 DI810 and 2 DO810	64 inputs 32 outputs	4.75
3	2 CONTRM with 32 × 2 input AND + 8 DI810 and 4 DO810	128 inputs 64 outputs	9.75
4	1 CONTRM with 32 × 2 input AND 1 CONTRM with 16 × 2 input ADD 4 AI810, 2 AO810, 4 DI810 and 2 DO810	80 inputs 48 outputs	6.75
5	1 CONTRM with 32 × 2 input AND 1 CONTRM with 16 × 2 input ADD 1 CONTRM with 5 × 4 MOVE(IL) 10 DSP with 4DAT(IL) each, 4 AI810, 2 AO810, 4 DI810 and 2 DO810	100 inputs 68 outputs	9.0
6	1 CONTRM with 32 × 2 input AND 1 CONTRM with 16 × 2 input ADD 1 CONTRM with 5 × 4 MOVE(IL) 50 DSP with 4DAT(IL) each, 4 AI810, 2 AO810, 4 DI810 and 2 DO810	180 inputs 148 outputs	13.75

Chapter 7 Environmental Immunities

7.1 General

Advant Controller 70 meets requirements specified in EMC Directive 89/336/EEC.

The S800 I/O family is designed and manufactured by ABB Automation Products AB in Sweden, which is certified according to the environmental protection standards ISO 14001.

For more information on the environmental immunity, including EMC qualities with CE-marking, please refer to the Environmental Immunities chapter in *Product Guide for Advant OCS with Master software, Overview.*

Grounding, cable selection and cable routing must be considered for electromagnetic interference-free operation. Planning considerations are discussed in the *S800 I/O User's Guide*.

Chapter 8 Ordering

Please order using Price List *Advant Controller 70 ver. 1.2* (**3BSE 014 386/A**) of Price Book *AC 55/70/110/160, AdvaSoft and OPC Server*, 3BSE 001 780/H.

8.1 Basic Unit

Table 8-1. Basic Unit

Description	Consists of	Article No.
Advant Controller 70 1.2, Basic unit consisting of: - CPU module incl. 2 × AF100 twp modems, 2 × 0.5MB FPROM, 0.5MB SRAM, Battery 2Ah, Power: 24 V d.c., max. 1A - Modulebus terminator - BASE software, Event handling.	PM810 TB807 On two 3.5” diskettes.	3BSE009895R2
Extra, Front label set for PM810		3BSE970089R1
Extra, Label set, item design. for PM810		3BSE970091R1
Lithium Battery, 3.6 V, size 14.5 × 25 mm, 900 mAH, for backup of RAM and clock on PM810		4943 013-6

8.2 Software Options

Table 8-2. Software Options

Description	Consists of	Article No.
SW option AC70 OPT Extended PC element set, version 1.2.	Software on 3.5” diskette.	3BSE009896R2
SW option AC70 OPT Modbus I version 1.0, MODBUS I protocol for HMI communication using the processor module(1)	Software on 3.5” diskette.	3BSE011276R1
System SW extension disk version 1.0 including: - interface library - extension loader - manual	Software on 3.5” diskette.	3BSE011280R1

(1) MODBUS connection kit is required

8.3 Upgrades and Updates

Table 8-3. Upgrade of System Software

Description	Consists of	Article No.
Upgrade AC70 BASE software version 1.2. Upgrade from earlier versions of AC 70.	Software on 3.5” diskette	3BDS005027R2
Upgrade AC70 OPT Extended PC element set 1.2 Upgrade from earlier versions.	Software on 3.5” diskette	3BDS005139R2
Upgrade AC70 OPT Modbus I 1.0. Upgrade from earlier versions.	Software on 3.5” diskette	3BDS005138R1
Upgrade System SW extension disk 1.0. Upgrade to version 1.0.	Software on 3.5” diskette	3BDS005137R1

Table 8-4. Update of System Software

Description	Consists of	Article No.
Update AC70 BASE software version 1.2. Update to latest revision.	Software on 3.5” diskette	3BDS005146R2
Upgrade AC70 OPT Extended PC element set 1.2. Update to latest revision.	Software on 3.5” diskette	3BDS005141R2
Upgrade AC70 OPT Modbus I 1.0. Update to latest revision.	Software on 3.5” diskette	3BDS005142R1
Upgrade System SW extension disk version 1.0. Update to latest revision.	Software on 3.5” diskette	3BDS005143R1

8.4 Communication

Table 8-5. Details for Advant Fieldbus 100

Description	Consists of	Article No.
Terminator 150 Ohm for twisted pair cable with impedance 150 ohm. Two required per AF 100 bus.	TC501V150	3BSC550038R3
AF 100 Trunk Tap. Main Trunk Cable Tap to Local Trunk Cable, Capac. Shield Decoupling. One required per AF100 connection	TC506	3BSC840074R1
AF100K03 Connection Kit, single for connection between TC630 and TC513	TK516 cable details	3BSE006251R1
Terminator Kit for coaxial cable, two terminators.		3BSE006244R1
AF 100 Conversion Modem coaxial to twist. pair or vice versa. Power 24 V d.c.	TC513V1	3BSE018405R1
AF 100 Conversion Modem twist. pair to opt. or vice versa	TC514V1	3BSE013240R1
AF 100 Repeater Modem. From twist. pair to twist. pair cable	TC515V1	3BSE013243R1
AF 100 Optical Modem with coaxial cable output. Power 24 V .d.c.	TC630	3BSE002253R1

Table 8-6. MODBUS

Description	Consists of	Article No.
MODBUS connection kit, TC 801 connects to PM810 via TK802	TC801 TK802	3BSE011788R1

8.5 S800 I/O Modules

Table 8-7. S800 I/O modules

Description	Consists of	Article No
Analog input, 1×8 channels, 12 bit resolution, single ended, 0 to 10V or 0 (4) to 20 mA, shunt 250 ohm, rated isolation 50 V.	AI810	3BSE008516R1
Analog input, 4×1 channels, 12 bit resolution, differential, -10 to 10V or -20 to 20 mA, shunt 150 ohm, rated isolation 50 V.	AI820	3BSE008544R1
Analog input, 1×8 channels, RTD Pt-100, Ni-100, Ni-120, Cu10, R, 14 bit resolution, rated isolation 50 V.	AI830	3BSE008518R1
Analog input, 8 channels, Thermocouple, 14 bit resolution, characteristics B, C, E, J, K, N, R, S, T, ± 75mV, rated isolation 50 V.	AI835	3BSE008520R1
Analog output, 1×8 channels, 14 bit resolution, 0 (4) to 20 mA, Rload max 500/1000 ohm, rated isolation 50 V.	AO810	3BSE008522R1
Analog output, 4×1 channels, 12 bit resolution, -10 to 10V or -20 to 20 mA, output load current <850 ohm, voltage > 500ohm, rated isolation 50 V.	AO820	3BSE008546R1
Digital input, 2×8 channels, 24 V d.c., rated isolation 50 V.	DI810	3BSE008508R1
Digital input, 2×8 channels, **48 V d.c**., rated isolation 50 V	DI811	3BSE008552R1
Digital input, 2×8 channels, 24 V d.c., current source, rated isolation 50 V.	DI814	3BUR001454R1
Digital input, 8×1 channels, 120 V a.c., individually electrical isolated channels, rated isolation 250 V.	DI820	3BSE008512R1
Digital input, 8×1 channels, 230 V a.c., individually electrical isolated channels, rated isolation 230 V a.c.	DI821	3BSE008550R1
Digital output, 2×8 channels, 24 V d.c., max 0.5 A, rated isolation 50 V, short-circuit proof transistor outputs, current sourcing.	DO810	3BSE008510R1
Digital output, 2×8 channels, 24 V d.c., max 0.5 A, rated isolation 50 V, short-circuit proof transistor outputs, current sink.	DO814	3BUR001455R1

Table 8-7. S800 I/O modules (Continued)

Description	Consists of	Article No
Digital output, 2×4 channels, 24 V d.c., max 2 A, rated isolation 50 V, short-circuit proof transistor outputs, current sink.	DO815	3BSE013258R1
Digital output, 8×1 channels, 24–230 V a.c., rated isolation 250V, individually electrical isolated channels relay outputs (n.o.)(1)	DO820	3BSE008514R1
Digital output, 8×1 channels, 24–230 V a.c., rated isolation 250V, individually electrical isolated channels relay outputs (n.o.)(2)	DO821	3BSE013250R1
Pulse Counter, 2 channels, RS-422, 5V, (12V), 24V, pulse count and frequency measurement, 1.5 MHz, rated isolation voltage 50 V.	DP820	3BSE013228R1
Extra Front label set for I/O box, 4 ch		3BSC970060R1
Extra Front label set for I/O box, 8 ch		3BSC970088R1
Extra Front label set for I/O box, 16 ch		3BSC970087R1

(1) Relay data: Load current: min 5mA, max 3A, at 250 V a.c. or 40W d.c.
Breaking capacity: 1000VA or 240 W at cos j > 0.4

(2) Relay data: Load current: min 5mA, max 3A, at 250 V a.c. or 40W d.c.
Breaking capacity: 1000VA or 240 W at cos j > 0.4

Table 8-8. Details for Module Bus Termination Units

Description	Consists of	Article No
Module termination unit (MTU), compact, 2×8 signal terminals, rated isolation 50 V	TU810V1	3BSE013230R1
Module termination unit (MTU), compact, 1×8 signal terminals, rated isolation 250 V	TU811V1	3BSE013231R1
Module termination unit (MTU), compact,25 pin D-sub connector, rated isolation 250 V	TU812V1	3BSE013232R1
Module termination unit (MTU), compact, 2×8 signal terminals, rated isolation 50 V	TU814V1	3BSE013233R1

Table 8-8. Details for Module Bus Termination Units (Continued)

Description	Consists of	Article No
Module termination unit (MTU), extended, 2×16 signal terminals, rated isolation 50 V	TU830V1	3BSE013234R1
Module termination unit (MTU), extended, 2×8 signal terminals, rated isolation 250 V	TU831V1	3BSE013235R1
Module termination unit (MTU), extended, 2×8 signal terminals, individually fused, rated isolation 50 V	TU835V1	3BSE013236R1
Module termination unit (Extended MTU), Two isolated groups each with one row of 4 uncommitted terminals individually fused (3A) (1), one row of 4 uncommitted terminals, 2 pcs L+ and 2 pcs L2- terminals. Rated isolation voltage 250V. Conductor area: solid 0.2-4 mm^2, stranded 0.2-2.5 mm^2, AWG 24-12	TU836V1	3BSE013237R1
Module termination unit (MTU), extended, 8×1 fused isol. signals, 8×1 L terminals, 2×6 N terminals, rated isolation 250 V	TU837V1	3BSE013238R1
Module termination unit (MTU), extended, 2×4 fused transducer power outlets, 16 signal terminals, 2×4 return terminals, 2×2 L-, 2×2 L+ terminals, Rated isolation 50V.	TU838	3BSE008572R1
Extra Label set for MTU (item designation)		3BSC970090R1

(1)The standard fuse holder can be changed to a fuse holder with status indication. The fuse holder with indication can be ordered from Phönix according to 3118119 (15-30V d.c.) UNSKILLED 24 STICKER or 3118106 (110-250V a.c.) UNSKILLED 250 STICKER.

Table 8-9. Communication parts for Module Bus

Description	Consists of	Article No
Cable adaptor, output, D-sub 25, female	TB805	3BSE008534R1
Cable adaptor, input, D-sub 25, male	TB806	3BSE008536R1
Extension cable(1) for Module Bus, 0.3 m (1ft.)	TK801V003	3BSC950089R1
Extension cable[1] for Module Bus, 0.6 m (2ft.)	TK801V006	3BSC950089R2
Extension cable[1] for Module Bus, 1.2 m (4ft.)	TK801V012	3BSC950089R3

Table 8-9. Communication parts for Module Bus (Continued)

Description	Consists of	Article No
Module Bus Terminator	TB807	3BSE008538R1
Modulebus Optical Port for PM810 to connect S800 I/O	TB810	3BSE008560R1
Modulebus Optical Port for PM810 to connect drive modules	TB811	3BSE008568R1
Optical Modulebus Modem	TB820V1	3BSE013246R1
Optical Modulebus Expansion cable, duplex plastic fibre, 1.5 m (5 ft.)	TK811V015	3BSC950107R1
Optical Modulebus Expansion cable, duplex plastic fibre, 5 m (16.7 ft.)	TK811V050	3BSC950107R2
Optical Modulebus Expansion cable, duplex plastic fibre, 15m (49 ft.)	TK811V150	3BSC950107R3
Optical Modulebus Expansion cable, simplex plastic fibre, 1.5 m (5 ft.)	TK812V015	3BSC950118R1
Optical Modulebus Expansion cable, simplex plastic fibre, 5 m (16.7 ft.)	TK812V050	3BSC950118R2
Optical Modulebus Expansion cable, simplex plastic fibre, 15 m (49 ft.)	TK812V150	3BSC950118R3

(1) One set of TB805 and TB806 per each extension cable is required

Table 8-10. Power supply

Description	Consists of	Article No
Power supply, rated isolation 250 V Input: 100–240 V a.c. Output: 24 V d.c., 2.5 A	SD811	3BSC610022R1
Power supply, rated isolation 250 V Input: 100–240 V a.c. Output: 24 V d.c., 5 A	SD812	3BSC610023R1

Table 8-11. Wall cabinets

Description	Consists of	Article No
Wall cabinet, IP65, W×H×D 800×1000×300 mm (32×40×12 inch)	RE810	1TSA 382210-A

Table 8-11. Wall cabinets

Description	Consists of	Article No
Top hat rail (DIN) 35×7.5 mm (1.4×0.3 inch) L=700 mm (27.5 inch)		1TSA 382110-13
Top hat rail (DIN) 35×7.5 mm (1.4×0.3 inch) L=1200 mm (47.2 inch)		1TSA 382110-14

8.6 Documentation

Table 8-12. Documentation

Title	Description	Article No.
Advant OCS User Documentation on CD-ROM	CD-ROM containing all manuals listed below in this table. For subscription please contact: ABB Automation Products Service & Training Center S-721 59 Västerås Sweden Telephone +46 21 342 000	3BSE008143R1001
Advant OCS Installation Rules User's Guide	User's Guide describing the installation rules for Advant OCS, to ensure correct function in environments where disturbance are present	3BSE009178R1 Rev. A
Advant Controller 70 User's Guide	User's Guide describing the AC 70 equipment and how to install and commission the system	3BUR000874R301
S800 I/O User's Guide	User's Guide describing the entire S800 I/O System equipment and how to install and commission the system	3BSE008878R301
S800 E/A Benutzerhandbuch	User's Guide describing the entire S800 I/O System equipment and how to install and commission the system in German.	3BSE008878R0103

Table 8-12. Documentation

Title	Description	Article No.
AMPL Configuration Advant Controller 100 Series Reference Manual	Contains instructions about configuration and application programming, fault tracing, execution, memory and load calculation of AC 110, AC 160, AC 70 and AC 55	3BSE009626R301
PC Elements Advant Controller 70 Series Reference Manual	Reference Manual describing the PC Elements used with Advant Controller 70	3BSE009177R201
Data Base Elements Advant Controller 70 Series Reference Manual	Reference Manual describing the DB Elements used in Advant Controller 70	3BSE009456R201
Advant Fieldbus 100 User's Guide	Complete technical manual for AF 100, containing a technical description, technical data and instructions for installation, commissioning and fault tracing.	3BSE000506R701
Advant Fieldbus 100 Benutzerhandbuch	Complete technical manual for AF 100 in German, containing a technical description, technical data and instructions for installation, commissioning and fault tracing.	3BSE000506R0303
S800 I/O Terminal Diagram form package	Complete technical manual for AF 100, containing a technical description, technical data and instructions for installation, commissioning and fault tracing.	3BSE011778R0001